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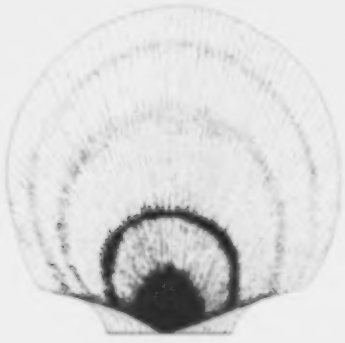
Canadian Science Advisory Secretariat
Science Advisory Report 2013/059

# ASSESSMENT OF BROWNS BANK NORTH SCALLOPS (*PLACOPECTEN MAGELLANICUS*)



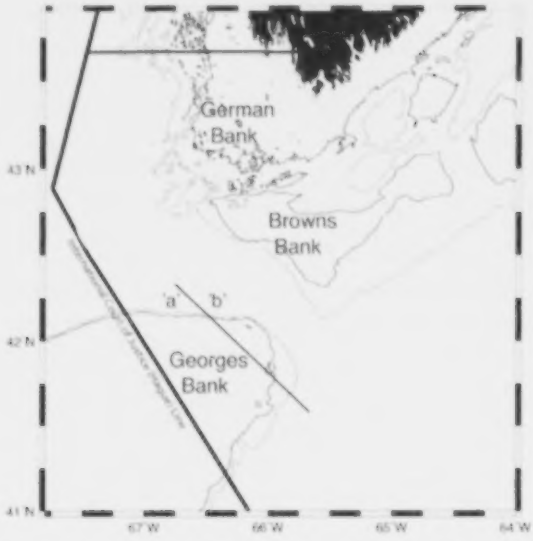



*Figure 1. Location of Browns Bank north and south.*

## Context:

*The sea scallop, Placopecten magellanicus, is found only in the Northwest Atlantic, from Cape Hatteras to Labrador. Scallops are aggregated in patches and harvestable concentrations are called beds. Major areas of offshore fishing activity are Browns Bank, Browns Bank, German Bank, the Eastern Scotian Shelf (Banquereau, Middle Bank, Sable and Western banks), and St. Pierre Bank (south of Newfoundland). Scallops prefer a sandy, gravel bottom and occur in depths of 35 to 120 m on the offshore banks.*

*The offshore scallop fleet consists of wet fish vessels and freezer-trawlers. Generally, these vessels simultaneously fish two New Bedford offshore rakes, ranging from 4.3 to 5.2 m width, one on each side of the vessel.*

*Annual assessments of the status of the offshore scallop resource take into account the annual survey findings, meat size distribution in the catch, and fishery performance. The management of the main scallop fishery on Browns Bank refers to the northern part of the bank (Fig. 1). Browns Bank south is a marginal growth area for scallops and has separate management measures. The assessment and advice presented in this document use the assessment framework established in 2009 for Browns Bank.*

*In support of management of the Browns Bank north 2013 scallop fishery, a meeting of the Science Advisory Process was held 1 May 2013 at the Bedford Institute of Oceanography in Dartmouth, N.S., to: (1) assess the status of the resource; and (2) provide harvest advice for the 2013 fishery.*

## SUMMARY


- The 2012 TAC was 500 t for Browns Bank north and total reported landings were 475 t.
- The commercial catch rate in 2012 was at the long-term median (1991-2009).
- In 2012, the survey index for pre-recruits was similar to what it was in the early 2000s and well below the 21-year (1991-2011) median. The 2005 year-class is now mainly fully recruited to the fishery and survey indices of recruit and fully recruited scallops were near their respective 21-year (1991-2011) median levels.
- The overall condition factor for Browns Bank north in May 2012 was 11.83 g/dm$^3$. This was an increase from 11.03 g/dm$^3$ in 2011 but is still below the long term mean of 12.62 g/dm$^3$.
- Fully recruited biomass, estimated to be 5,950 t in 2012, increased slightly from the 2011 estimate (5,504 t) and is approximately equal to the 21-year median biomass of 5,807 t
- The 2013 interim TAC of 750 t will result in an exploitation rate of 0.13. Biomass is expected to remain relatively stable, however there is little indication of strong year classes in the near future.
- Harvest scenarios ranging from 200 t to 1000 t were examined and all had moderate (0.40-0.56) probability of decline in commercial biomass for 2013. Biomass change ranged from 9 to -5 % for the range of catches considered here.


## BACKGROUND

A meeting of the Science Advisory Process was held 1 May 2013 at the Bedford Institute of Oceanography (BIO), in Dartmouth, Nova Scotia to review the 2012 fishery and assess the status of the scallop stock on Browns Bank in support of the management of the 2013 fishery. Participants included DFO scientists, fishery managers, representatives of Aboriginal organizations, and representatives of the industry.

## ASSESSMENT

### Fishery

The 2012 TAC was 500 t for Browns Bank north and total reported landings were 475 t (Table 1). Based upon preliminary analysis of the 2013 fishery data and the annual stock survey data, an interim TAC of 750 t was set for the 2013 Browns Bank north fishery. No fishery has occurred on Browns Bank south since 2007 and an interim TAC of 10 t has been set for 2013. Effort measured in hours fished multiplied by gear width in metres (hm) decreased from 38,532 hm in 2011 to 19,291 hm 2012. The annual catch rate has decreased slightly from 26.65 kg/hm in 2011 to 24.65 kg/hm in 2012 and is near the long-term median of 23.09 kg/hm (Figure 2).

*Table 1. Landings of sea scallop meats from Browns Bank and total allowable catch (TAC), in metric tons. Since 1998, Browns Bank has been divided into north and south management areas*

| Year | Catch (t) | TAC (t) |
|---|---|---|
| 1981 | 25 | -- |
| 1982 | 156 | -- |
| 1983 | 106 | -- |
| 1984 | 28 | -- |
| 1985 | 16 | -- |
| 1986 | 5 | -- |
| 1987 | 0 | -- |
| 1988 | 5 | -- |
| 1989 | 337 | 400 |
| 1990 | 207 | 200 |
| 1991 | 215 | 220 |
| 1992 | 454 | 450 |
| 1993 | 575 | 600 |
| 1994 | 1403 | 1400 |
| 1995 | 2002 | 2000 |
| 1996 | 743 | 750 |
| 1997 | 500 | 500 |

| Year | Catch (t) | | TAC (t) | |
|---|---|---|---|---|
| | north | south | north | south |
| 1998 | 500 | 98 | 500 | 100 |
| 1999 | 200 | 293 | 200 | 300 |
| 2000 | 748 | 200 | 750 | 200 |
| 2001 | 999 | 99 | 1000 | 100 |
| 2002 | 649 | 98 | 650 | 100 |
| 2003 | 1003 | 97 | 1000 | 100 |
| 2004 | 2007 | 185 | 2000 | 200 |
| 2005 | 1068 | 38 | 1075 | 100 |
| 2006 | 912 | 14 | 1050 | 100 |
| 2007 | 1198 | 1 | 1200 | 50 |
| 2008 | 393 | 0 | 400 | 0 |
| 2009 | 0 | 0 | 0 | 0 |
| 2010 | 201 | 0 | 200 | 0 |
| 2011 | 1027 | 0 | 1000 | 0 |
| 2012 | 475 | 0 | 500 | 0 |

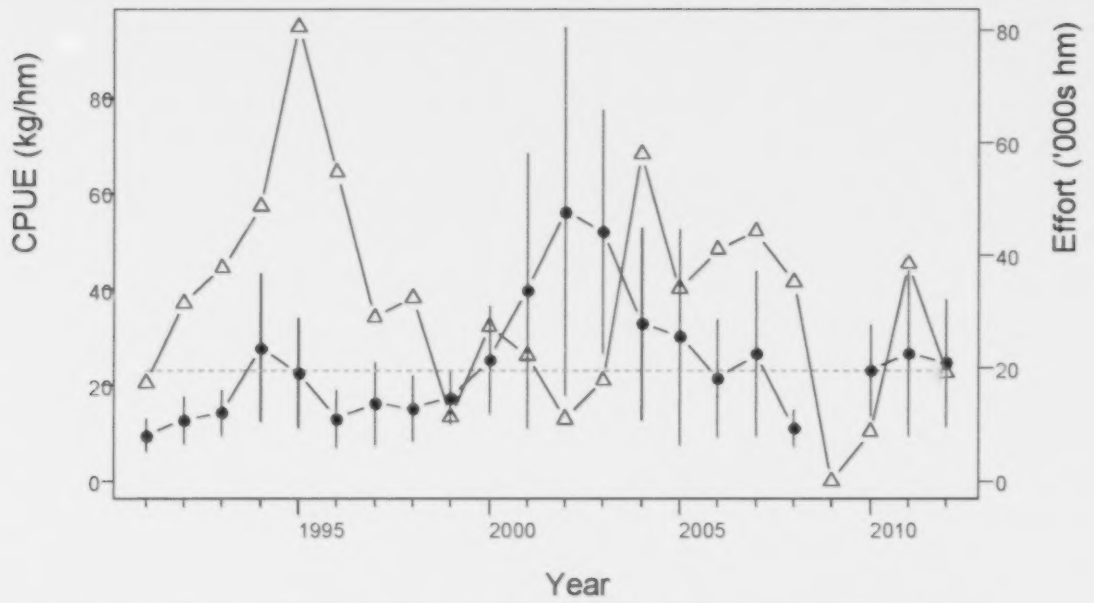



*Figure 2. Annual catch per unit effort (CPUE, kg/hm, with jackknifed standard deviations) (•) and effort (hm) (Δ), for Browns Bank 'a'. The dashed line is the 21-year median CPUE value.*

## Survey

The survey index for pre-recruits (<85 mm shell height) in 2012 was 88 scallops per tow, similar to what it was in the early 2000s and well below the 21-year (1991-2011) median of 411 scallops per tow (Figure 3). The large cohort (2005 year-class) observed in the 15 to 50 mm range in 2007 is now mainly fully recruited in the 85 to 115 mm range (Figure 4) and the abundance of recruit scallops has returned to near median levels (Figure 3). The abundance of fully recruited scallops has remained fairly stable since 2010, at 237 scallops per tow it is just above 21-year (1991-2011) median of 205 scallops per tow (Figure 3).

Shell height and meat weight data from the survey were analyzed to see how the condition varies over time. Condition refers to the meat weight relative to shell height and fluctuates depending on environmental variables that vary annually and spatially. The overall condition factor for Browns Bank north in May 2012 was 11.83 g/dm$^3$ (meaning that on average a scallop with a 100 mm shell would have an 11.83 g meat). This was an increase from 11.03 g/dm$^3$ in 2011 but is still below the long term mean of 12.62 g/dm$^3$ (Figure 5).

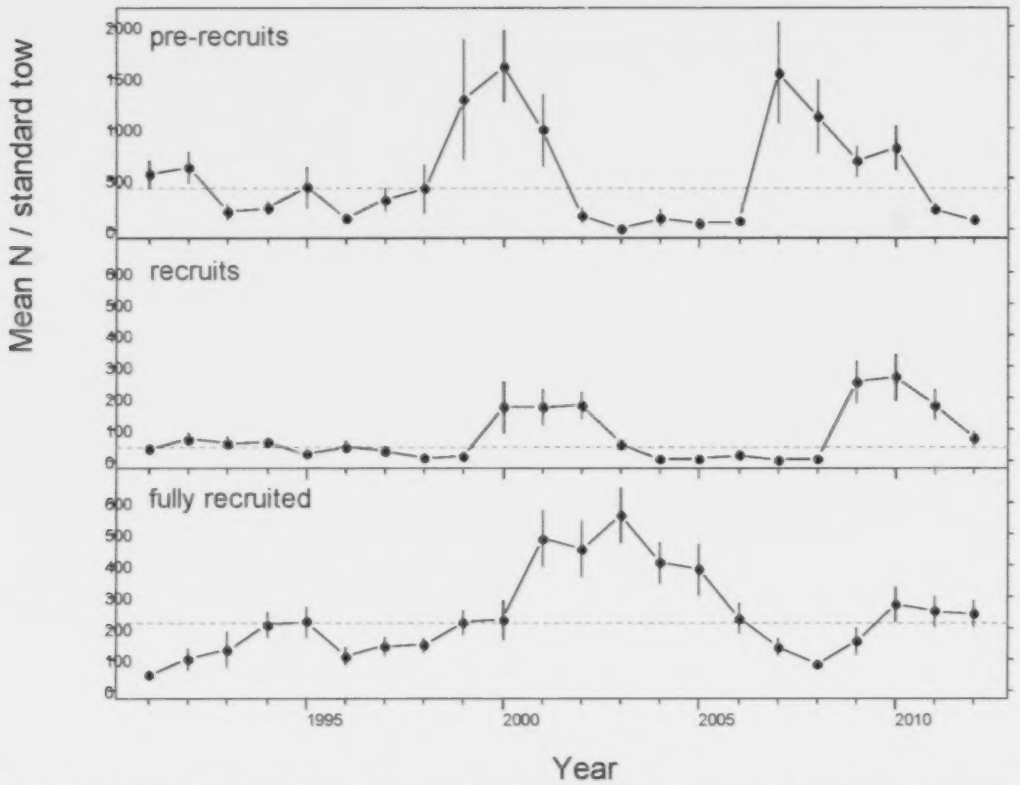



*Figure 3. Survey abundance indices (mean number/standard tow) for pre-recruit (<85 mm), recruit (85-94 mm) and fully recruited (≥95 mm since) scallops. The horizontal dashed lines are the 21-year median value for each size class and the solid vertical lines are ± 1 standard error.*

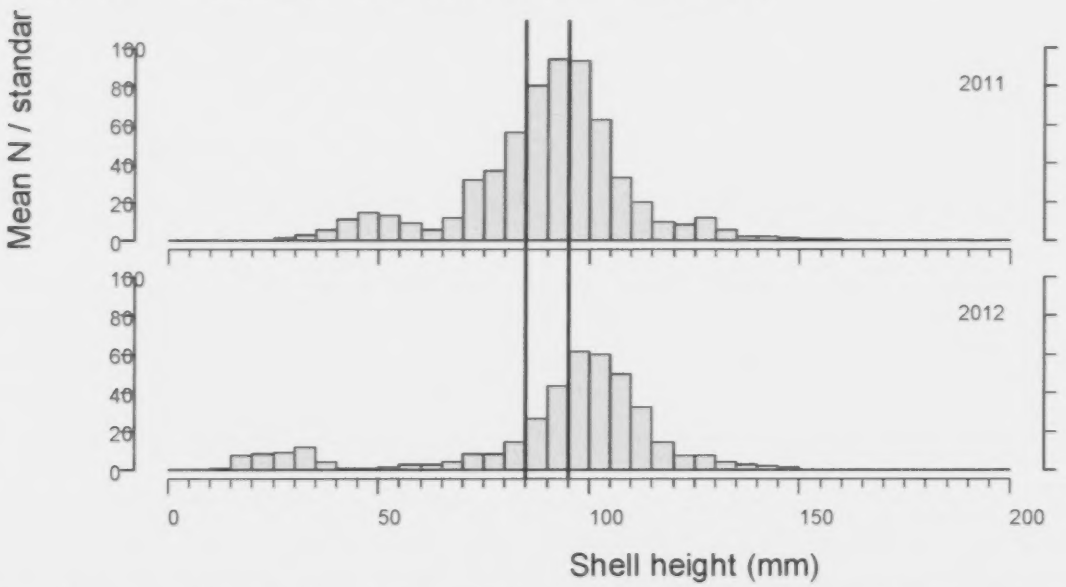



*Figure 4. Mean number of scallops at shell height (mean number/standard tow) from the Browns Bank north survey. The vertical lines indicate the divisions between pre-recruit, recruit and fully recruited size classes.*

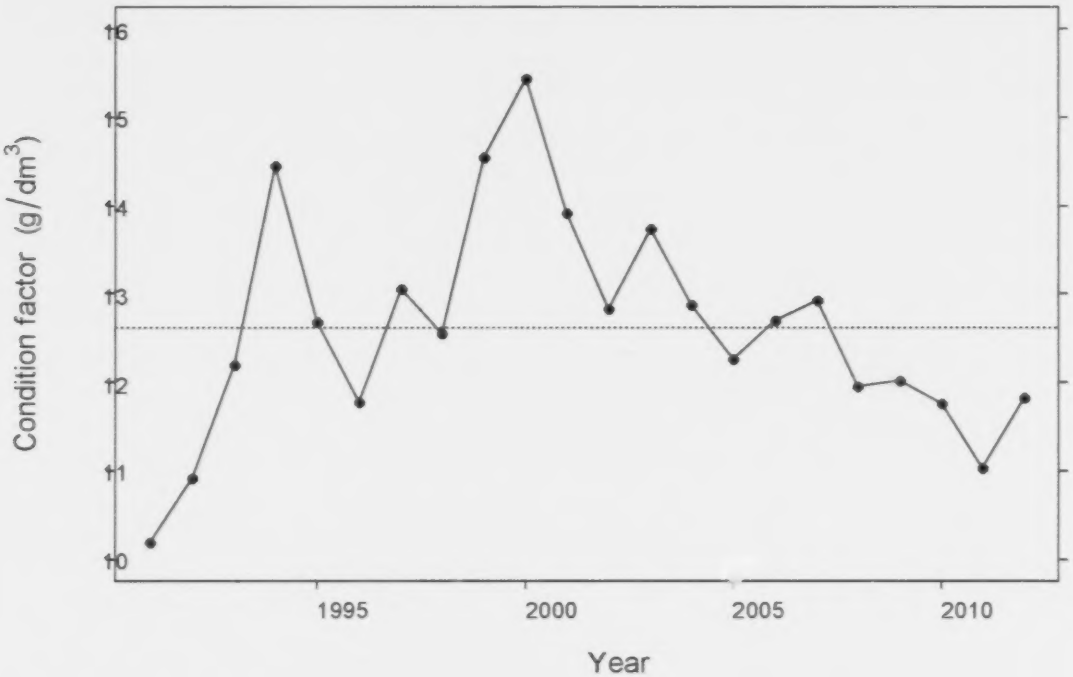



*Figure 5. Overall annual condition factor calculated from shell height and meat weight data collected from the August survey. The horizontal dashed line is the 22-year mean value.*

## Population Model

The stock assessment model, described in Jonsen et al. (2009) with recent improvements described in Hubley et al. (2013), was fit to the survey and commercial catch rate indices on Browns Bank north from 1991 to 2012 to estimate commercial biomass and exploitation, as well as to provide 2013 biomass projections and harvest scenarios. Improvements included considering fishery data between surveys (June in year t to May in year t+1) and incorporating standard errors from the indices into estimates of observation error in the model. Non-harvest mortality, and its uncertainty, was estimated using an index of dead scallops (paired shells) from the survey, effectively accounting for the lack of reliable information with regard to mortality resulting from discards, incidental fishing and natural sources. Changes in annual condition were also included in the growth estimates along with new growth parameters from recent age data.

Fully recruited biomass, estimated to be 5,950 t in 2012, increased slightly from the 2011 estimate (5,504 t) and is approximately equal to the 21-year median biomass of 5,807 t (Figure 6). Recruit biomass, estimated to be 857 t in 2012 declined from the 2011 estimate (1,819 t), but is still above the 21-year median biomass of 583 t. The model's forecast for 2013 biomass is 5,912 t, assuming a catch of 750 t (the interim TAC), no change in condition and natural mortality rates similar to 2012. Harvest scenarios ranging from 200 t to 600 t are predicted to yield modest increases in commercial biomass with a probability of decline ranging from 0.40 to 0.48 and harvest scenarios ranging from 700 t to 1000 t are predicted to yield modest decreases in commercial biomass with a probability of decline ranging from 0.50 to 0.56 (Table 2). Exploitation declined in 2012 to 0.08 from 0.14 in 2011 (Figure 7). The estimated non-

harvest mortality increased for both recruit and fully-recruited scallops to 0.19 and 0.15 in 2012, from 0.15 and 0.09 in 2011, respectively (Figure 39).

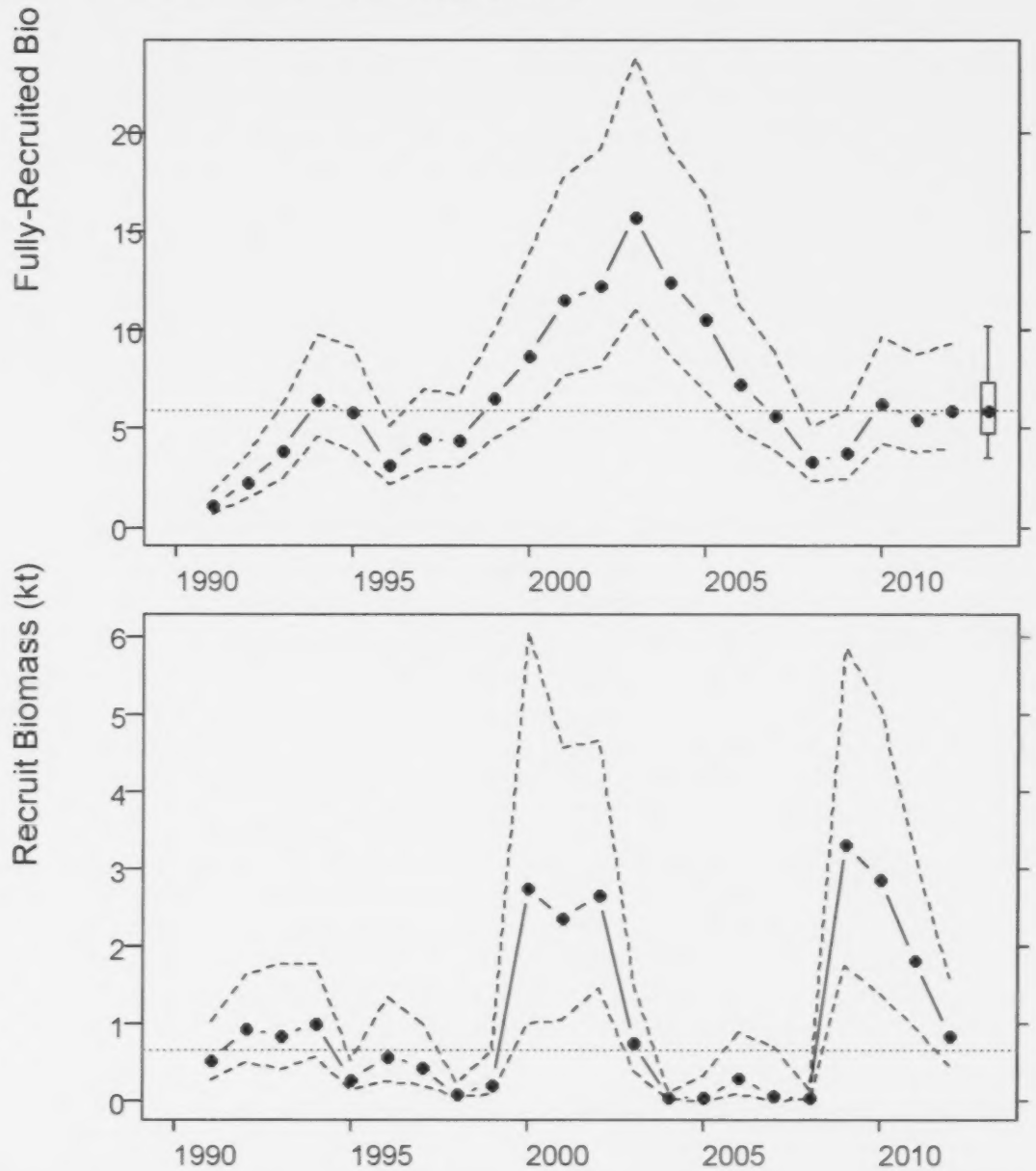



*Figure 6. Biomass estimates for recruit and fully recruited scallops from the stock assessment model fit to the Browns Bank north survey and commercial data. Dashed lines are the upper and lower 95% credible limits on the estimates and the dotted line represents the 21 year median. The forecasted fully recruited biomass for 2013, assuming a catch of 750 t, is displayed as a box plot with median (•), 50% credible limits (box) and 80% credible limits (whiskers).*

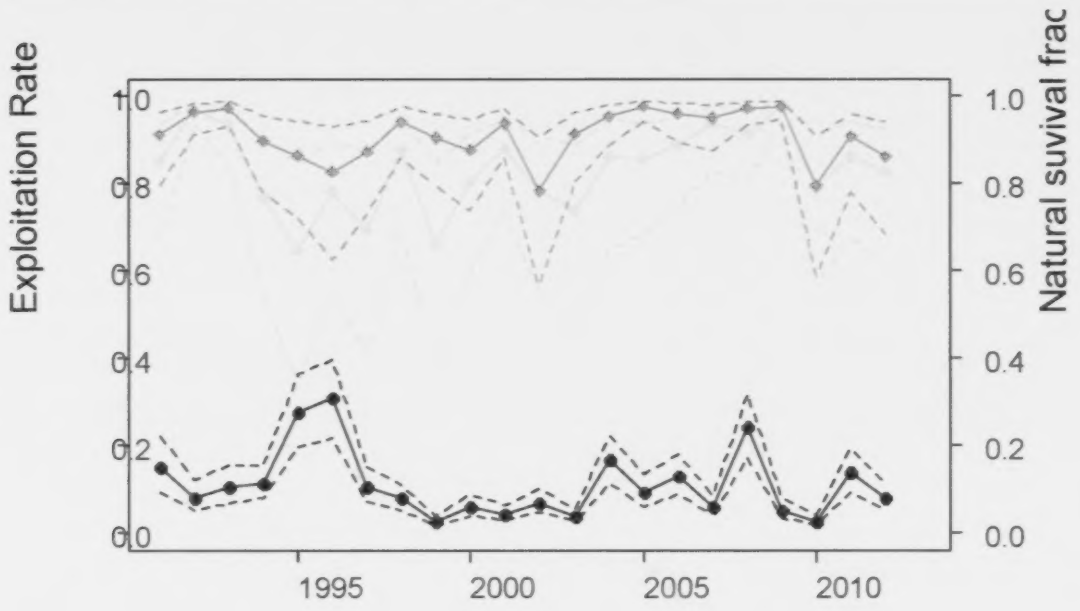



*Figure 7. Annual trends in exploitation (black line, circles) and survival estimates (exp(-m)), where m is natural mortality of fully recruited (grey line, squares) and recruit size scallops (green line, squares). Dashed lines are the upper and lower 95% credible limits on the estimates.*

## Sources of Uncertainty

Annual changes in condition are accounted for in the growth estimates from year to year but projections from the model assume no change in condition for 2013 because that data is not yet available. If condition declines or increases growth will likely be lower or higher than expected. Estimated parameters for shell growth do not account for annual vaiability although shell growth is expected to be less variable than condition.

## CONCLUSIONS AND ADVICE

The strong 2005 year class has now largely reached commercial size however there is little indication of strong year classes in the near future. The 2013 interim TAC of 750 t will result in an exploitation rate of 0.13. Biomass is expected to remain relatively stable at the current TAC (Table 2). Harvest scenarios ranging from 200 t to 1000 t were examined and all had moderate (0.40-0.56) probability of decline in commercial biomass for 2013. Biomass change ranged from 9 to -5 % for the range of catches considered here. (Table 2).

*Table 2. Harvest scenarios for Browns Bank north 2013 in terms of exploitation and expected changes in biomass. Potential catches in 2011 are evaluated in terms of the probability of a decline in biomass. These probabilities account for uncertainty in the biomass forecasts.*

| Catch (t) | Exploitation Rate | Probability of Biomass Decline | Expected Change in Biomass (%) |
|---|---|---|---|
| 200 | 0.05 | 0.40 | 9.31 |
| 300 | 0.06 | 0.42 | 7.27 |
| 400 | 0.08 | 0.44 | 5.01 |
| 500 | 0.09 | 0.45 | 4.37 |
| 600 | 0.11 | 0.48 | 1.83 |
| 700 | 0.12 | 0.50 | -0.04 |
| 750 | 0.13 | 0.51 | -1.06 |
| 800 | 0.14 | 0.52 | -1.42 |
| 900 | 0.15 | 0.55 | -3.95 |
| 1000 | 0.17 | 0.56 | -5.23 |

## SOURCES OF INFORMATION

This Science Advisory Report is from the May 1, 2013, Assessment of Georges and Browns Bank Scallop. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Hubley, P.B., Glass, A., Reeves, A., Sameoto, J., and Smith S.J. 2011. Browns Bank north Scallop (*Placopecten magellanicus*) Stock Assessment. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/042.

Hubley, P.B., Reeves, A., Smith, S.J., and Nasmith, L. 2013. Georges Bank 'a' and Browns Bank 'North' Scallop (*Placopecten magellanicus*) Stock Assessment. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/079.

Jonsen, I.D., A. Glass, B. Hubley, and J. Sameoto. 2009. Georges Bank 'a' Scallop Framework Assessment: Data Inputs and Population Models. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/034.

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